Computational Intelligence

Syllabus and Lecture Plan

Instructor

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R201,

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Office Hours

1pm ~ 3.30pm, Mon to Fri

Book in advance

Course Overview

Computational Intelligence (CI) is the study of adaptive mechanisms to enable or facilitate intelligence behavior in complex, uncertain and changing environments. These adaptive mechanisms include those artificial intelligence paradigms that exhibit an ability to learn or adapt to new situations, generalize, abstract, discover and associate1. The paradigms of CI are inspired from biology and nature, which covered artificial neural networks (ANNs), evolutionary computing (EC), swarm intelligence (SI), artificial immune systems (AIS) and fuzzy systems (FS). This course is in an introductory level and aims to introduce the fundamental concepts and applications of CI, such as basic concept, model, algorithm and systems, widely in machine learning, soft computing (fuzzy systems), nature inspired computing, model-based systems and qualitative reasoning. It will also make the students aware of how these components interact within the general domain of computational intelligence.

The prerequisite for this course are prior modules on Statistics, Mathematical Modelling and some programming background, such as Matlab, C++, Python, R etc.

Textbook

A. Engelbrecht, (2007), *Computational Intelligence: An Introduction*, (2nd ed.), John Wiley & Sons, Ltd, England. ISBN 0-470-84870-7.

https://www.wiley.com/en-us/Computational+Intelligence%3A+An+Introduction%2C+2nd+Edition-p-9780470035610

References

Barreto Arrieta A. et al. (2020). *Explainable Artificial Intelligence (XAI): Concepts, taxonomies, opportunities and challenges toward responsible AI*. Information Fusion, 58, pp. 82-115.

Craenen B., Eiben A. (2003): *Computational Intelligence*. In: Encyclopedia of Life Support Sciences, EOLSS Publishers Co.

Russell S., Norwig P. (2010). *Artificial Intelligence: A Modern Approach*, (3rd ed.), Prentice Hall. Available in the faculty library.

Marsland S. (2015). *Machine Learning: An Algorithmic Perspective*, (2nd ed.), CRC Press.

Sloman A. (2002). *The Irrelevance of Turing Machines to AI*. In Scheutz M. (ed.): Computationalism: New Directions, MIT Press, Cambridge, MA, pp. 87–127.

Woergoetter F., Porr B. (2008). *Reinforcement learning*, Scholarpedia, 3(3):1448.

Zadeh L. (2007). *Fuzzy logic*, Scholarpedia, 3(3):1766.

Course materials

- The accompanying website of this book, which can be located at http://ci.cs.up.ac.za, provides algorithms to implement many of the CI models discussed in this book.
- Computational Intelligence - A Logical Approach, you can find some good readings on https://www.cs.ubc.ca/~poole/ci.html
- Introduction to Computational Intelligence, Master Programme in Cognitive Science, Comenius University in Bratislava, http://dai.fmph.uniba.sk/courses/ICI/ http://dai.fmph.uniba.sk/w/Course:Introduction_to_computational_intelligence/en#References
- IEEE Computational Intelligence Society also hold a forum on https://cis.ieee.org/about/what-is-ci

Platform & Software

- MATLAB – PlatMEO : https://github.com/BIMK/PlatEMO
- Java – jMetal : http://jmetal.sourceforge.net/; http://jmetal.github.io/jMetal/
- Python - Evolutionary algorithm toolbox : https://github.com/geatpy-dev/geatpy
- *Software and Tutorials for Python* are available on http://www.cse.msu.edu/~ptan/dmbook/software/

Course Schedule

Week	Lectures	Practice Sessions
Week 1	Introduction to CI	Introduction of programming
Week 2	ANN-1 from neuron to perceptron	1st practical team-project start
Week 3	ANN-2 Multi-perceptron, Supervised Learning /Un, RL, DL..	Team work
Week 4	ANN3- Other topics and summary	1st team presentation & discussion
Week 5	EC-1 Benchmark problems and Evolutionary strategies	2nd practical team-project start

Week	Lectures	Practice Sessions
Week 6	EC-2 DE and Coevolution	Team work
Week 7	EC-3 Other topics and summary	2nd team presentation & discussion
Week 8	SI-1 Particle Swarm Optimisation	3rd practical team-project start
Week 9	SI-2 Ant algorithm and Artificial Bee Colony	Team work
Week 10	SI-3 Other topics and summary	3rd team presentation & discussion
Week 11	AIS-1 Natural Immune System	4th practical team-project start
Week 12	AIS-2 Artificial Immune Models and algorithms	Team work
Week 13	AIS-3 Other topics and summary	4th team presentation & discussion
Week 14	FS-1: Fuzzy Sets, Logic and Reasoning	5th practical team-project start
Week 15	FS-2: Fuzzy Controllers and Rough Sets	Team work
Week 16	FS-3: Other topics and applications	5th team presentation & discussion
Week 17	Revision	Revision
Week 18	Revision	Revision

Exam schedule

Week	Subject
Week 19	Final Exam which will be comprehensive and will contribute 70%.
Week 20	Deadline of assignments submissions, that will contribute 5%×5=25%. Attendance and performance in due course will contribute 5%.

Assignment Policy

Briefly, each practical assignment consists of three parts: data preparing or processing, model implementation and result analyzing to output a report document, better with no more than 3 pages (regular A4). It is recommended to use overleaf to edit your report, here is a link for PDF template, https://www.overleaf.com/latex/templates/template-relatorios-feelt31109/kxrpjkbqhshg, or you can find what you like. To achieve good mark, assignments should be submitted before ddl with clear and brief statements or calculation. For home exercise it is not limits on pages.

Additional information

Course Forum: See blackboard (BB)

Social Network: WeChat 137 2677 1160